Paying bills*

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Abstract

paying bills

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1. Pitch

This paper looks at whether utilities in developing countries provide an important source of credit to households by letting them not pay their bill? And how do these benefits compare to the costs of delinquency?

Motivation : (1) around the world, there are restrictions on when utilities can disconnect people (health, low-income, elderly), motivated by providing a sense of insurance; (2) Also, in developing countries, pre-paid metering where utilities essentially put fancy meters that only distribute water when people pay first. these shut off any credit channel but eliminate delinquency

Context : In Manila, water bills make up about 3% of income on average, jumps to 5 to 10% for low-income folks. I have data from a large water provider serving half the city of Manila. On average, people make a payment in three out of four months and are about a month behind in payments. For example, if you don't pay for three months, that's like taking a three-month loan of around 9% of your income.

People might be paying infrequently because they are credit-constrained and consumption smoothing; or it might just be a pain to pay their bills so they just avoid the hassle by paying infrequently (and they have plenty of other opportunities to smooth).

I use disconnection threats to better isolate the role of credit constraints. Workers will occasionally visit delinquent customers and say if you don't pay your bill soon (within 12 days on average), we'll disconnect you. Only 23% of people say that's "enough time" to pay the bill. After the threats, payments spike to double the average bill, delinquency drops to zero, and consumption drops by around 25%. If it were simply a hassle, people would pay their bill and consumption wouldn't change (they could get easy credit from other places and pay the bill); but if they are credit constrained, they have to deviate from consumption smoothing to make the payments. The next step is to use theory to see what this decrease in consumption implies about the short-term interest rate that households face.

2. Introduction

2.1. Question

Are utilities providing an important source of credit to households by letting them not pay their bill?

2.2. Motivation

- Disconnection policies as insurance (in the US)
  - weather, health, low-income
  - mandate that utilities amortize arrears
  - Utilities even tolerate greater non-payment

- At the same time, pre-paid metering is growing like crazy in the developing world (Sources)

2.3. Descriptives

- Avg Income: 22,000 PhP (488 USD) [Bill 3%]
- Avg Savings: 4,300 PhP (96 USD)
- 20% Income: 8,300 PhP (184 USD) [Bill 7.6%]
- 20% Savings: 330 PhP (7 USD)
- Avg Bill: 630 PhP (14 USD)
- Make payments 75% of months
- Avg delinquency: 30 days
- Avg Payment Amount: 830 PhP (18 USD)

But : might just be inconvenient to pay every month (but its really easy to pay bills in this context)

How can I ballpark this against the consumption smoothing literature?

2.4. Approach

Disconnection : Don't pay bill; come and threaten disconnection

- avg days to pay : 12 days (only 23% say that's enough time)
- if you (agree to?) pay, you are reconnected after 2 days
- 30% of connections are threatened with disconnection
- (small percent actually disconnect)
- Pay (+1) 800 PhP (+2) 300 PhP = total 1100 PhP (24 USD) [about two water bills on average]
- Consumption drops by about 20% for two months (there is a pre-trend which can be interpreted as positive demand shocks)

Theory :

- suddenly this source of credit is cut off (loan with uncertain payback date)
- concave utility predicts that households would want to smooth consumption (could get another loan, then fund consumption in that period)
-

3. Data

To measure water consumption and payments, I partnered with a large water provider in Manila who shared administrative data on over 1.5 million water connections. These data include water consumption and payment data as well as disconnection status.

Describe notice of disconnection in more detail here???

used to measure water consumption and payment data comes from monthly administrative data from a large water provider in Metro Manila

The 2015 Family Income and Expenditure Survey provides household income measures, which help to calibrate the structural model.

STICK WITH ONE HOUSEHOLD PER METER IN THIS PAPER! EXPLAIN THIS IN THE DATA SECTION! CONNECT TO FIES DATA AS WELL!!

4. Credit through Unpaid Water Bills

Table 1. Mean Characteristics

	Mean	SD	Min	25th	75th	Max
Usage (m3)	24.9	17.0	0.0	14.0	32.0	200.0
Bill	692	927	-4,640	265	854	78,409
Unpaid Balance	1,523	4,611	-4,995	0	1,126	79,904
Share of Months with Payment	0.71	0.45	0.00	0.00	1.00	1.00
Payment Size	924	1,147	0	316	1,082	62,879
Days Delinquent	50.2	133.6	0.0	0.0	31.0	720.0
Delinquency Visits per HH	0.42	0.71	0.00	0.00	1.00	6.00
Share of Months Disconnected	0.04	0.19	0.00	0.00	0.00	1.00

Total Households: 34,406 Obs. per Household: 61.7 Total Obs.: 2,123,335

Unpaid water bills may provide a reliable source of low-cost credit to households because (1) the company tolerates high rates of delinquency before disconnecting them from service and (2) the water company is prohibited from charging any interest on outstanding balances.

At the end of each month, the water company sends meter readers who record monthly consumption for each connection and then use a mobile device to print and deliver the bill to the household in person. The household is then expected to pay the bill by the end of the month. Households have many options to pay their bills with 79% using small payment centers (mall kiosks, gas stations, convenient stores, etc.), 17% paying at local water company offices, and 3% paying over phone, online, or via ATM kiosks.[1] Despite easy payment mechanisms, households rarely pay their bills on time. Table 1 provides summary statistics on the usage, billing, and payment patterns of households. On average, households are 50.2 days behind in their payments.

[1]Figures are tabulated from the connection survey sample.

Households also make large, infrequent payments. While the average bill is 691.6 PhP per month, payment sizes average 1,529.0 PhP and households make payments in only 71% of months. These payment patterns leave an average total outstanding balance of 1,523.0 PhP per month.

Given average monthly household incomes of 31,910 PhP and savings rates of 4,836 PhP in Manila, unpaid water bills reach 4.8% of income and 31.5% of savings on average each month. For households at the 20th income percentile, unpaid water bills jump to 10% of monthly income. As a benchmark, Cull et al. [2009] survey microfinance institutions throughout the developing world and find median yearly loan sizes expressed as a share of the 20th percentile of household income at 48% for nongovernmental organizations (NGOs), 160% for nonbank financial institutions, and 224% for banks. These descriptives suggest that a yearly loan from an NGO could be reached with around 5 months of unpaid water bills for households at the 20th income percentile.[2] Moreover, microfinance loans charge high yearly interest ranging from 25% for NGOs to 13% for banks. In comparison, unpaid water bills are interest-free, but households face some risk of service disconnection for delinquency.

After bills have remained unpaid for at least 60 days, the government regulator permits the water company to visit delinquent households to disconnect their water service.[3] Likely due to time and travel costs, delinquency visits are relatively rare in practice, occurring in only 0.70% of household-month observations. This probability increases to 2.90% for household-months over 60 days overdue. Figure 1 plots the share of months with delinquency visits according to days overdue. The risk of delinquency visits spikes at 61 days overdue before settling to around 2.5% at higher levels of delinquency. Appendix Table 6 predicts delinquency visits with days overdue, outstanding balance, and household characteristics. This exercise finds that days overdue and unpaid balances are strongly and independently correlated with visits while demographic indicators have weaker associations.

When company staff conduct delinquency visits, households often negotiate for additional time to pay their outstanding balances. 96% of households report agreeing to pay within 30 days and the average grace period is 13 days; however, only 25% of connections report having "enough time" to make their payments. For households who fail to pay, disconnection typically involves workers from the water company placing a metal lock on the water meter stopping the flow. In order to reconnect, households must pay a small, one-time fee of 200 PhP on top of settling any outstanding balances. The water company is then required to restore service within 48 hours of receiving full payment for reconnection, which is confirmed in survey data.[4]

Table 2 provides mean characteristics according to whether and how households

[2]Deal with income effects on water consumption!

[3]Regulations also require the water company to issue written statements to households, notifying them that their connections will be disconnected in 7 days if their outstanding balances remain unpaid. In practice, only 36% of disconnected households report receiving advanced notice. All percentages are calculated from 924 respondents who report being visited for disconnection in the past year out of 34,406 total respondents in the connection survey.

[4]Households report being reconnected 2.3 days after payment.

Figure 1. Share of Households that Receive a Delinquency Visit depending on Days Delinquent in the Previous Month

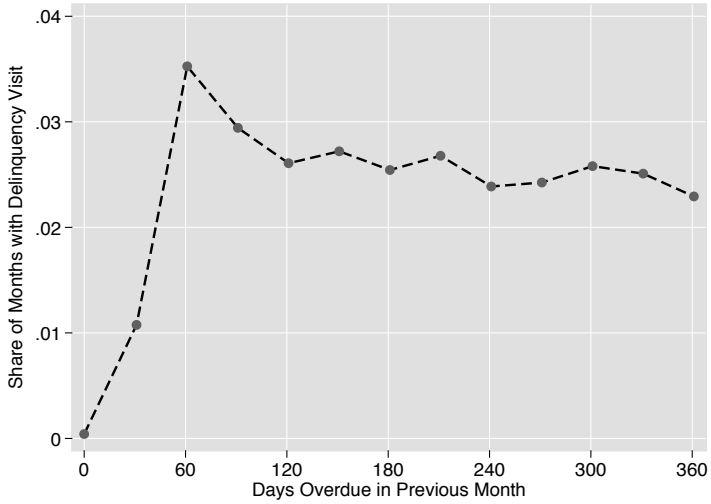


Table 2. Mean Characteristics by Delinquency Visit Status

	Never Visited	Stayers	Leavers
Usage (m3)	24.3	26.2	26.3
Bill	658	761	833
Unpaid Balance	706	2,416	6,520
Share of Months with Payment	0.78	0.60	0.38
Payment Size	829	1,214	1,247
Days Delinquent	18.9	84.9	236.5
Delinquency Visits per HH	0.00	1.32	1.42
Months Disconnected	0.01	0.03	0.31
HH Size	5.2	5.6	5.7
Age of HoH	47.4	44.8	45.8
Low Skilled HoH	0.14	0.17	0.19
Total Households	23,727	8,260	2,419
Total Observations	1,464,945	509,959	148,431

"Never Visited" includes HHs that never receive a delinquency visit.
"Stayers" includes HHs with ≥1 visit and are connected for the last 6 months.
"Leavers" includes HHs with ≥1 visit and are disconnected for ≥1 of the last 6 months.
Bill, Unpaid Balance, and Payment Size are in PhP/month.

respond to delinquency visits over the course of the sample. The first column, "Never Visited," includes households that never receive a delinquency visit. Since delinquency visits are relatively rare, the majority of observations fall into this category. The second and third columns include households that receive at least one delinquency visit. The second column, "Stayers," also requires that households are connected for the final 6 months of the sample while the third column, "Leavers," includes households that are

disconnected for at least one of the final 6 months of the sample.

Leavers are predominantly composed of households that permanently disconnect over the sample period, which likely occurs when households move out of their current residences. These households often leave large outstanding balances that are almost never repaid due to difficulties tracking households across locations. By incentivizing households to pay, frequent delinquency visits provide a strategy for the company to minimize this lost revenue.

Stayers include households that remain connected at the end of the sample despite receiving at least one delinquency visit over the duration.[5] Compared to households that are never visited, stayers have much higher outstanding balances and days delinquent. Their payments also occur less frequently but have larger average sizes. Stayers spend 3% of the sample period disconnected from service. Until they are able to pay for reconnection, these households likely substitute to alternative water sources including sharing with neighbors, using from deepwells, or purchasing from local water vendors.[6] Stayers also have slightly larger household sizes, younger heads of household, and greater incidence of low-skilled employment than never visited households. These demographic patterns are consistent with lower-income households having greater difficulty paying their bills promptly.

To investigate the timing of household responses to delinquency visits, Figure 2 plots monthly mean outcomes in months relative to the first delinquency visit for each household. Outcomes are plotted separately for all households that experience delinquency visits as well as stayer households who experience visits and also remain connected for the last 6 months of the sample. In the months just preceding a visit, monthly payments (Figure 2d) decrease suddenly, leading to corresponding increases in unpaid balances (Figure 2b) and days overdue (Figure 2c). Average consumption (Figure 2e) increases slightly as well. Prior to disconnection, stayers follow similar patterns but with lower levels of delinquency than the population average.

Immediately following the first delinquency visit, monthly payments spike as many households pay their full outstanding balances to prevent any disconnection. Despite these payments, the average share of households disconnected (Figure 2a) also spikes to around 24% before decreasing, as some households pay for reconnection, and stabilizing at 17%, which is likely composed of households who have permanently disconnected. Stayer households pay more and disconnect less than the population average following a visit. Disconnection rates for stayers spike to 15% before declining to around 4% two years later.[7] The decline among stayers accounts for much of the average decline in disconnection rates across the sample. Although many stayers quickly reconnect within 6 months, reconnections continue accumulating up to one year after

[5]Stayers also excludes 45 households that the company has flagged as "permanently disconnected."

[6]Table 2 indicates that even for households that are never visited, they are disconnected during 1% of months. These disconnections include (1) households that received a delinquency visit before the start of the sample (but later reconnected) and (2) households that notify the water company about their moving plans in advance and therefore, do not need a delinquency visit.

[7]Although stayers are connected for the last 6 months of the sample by definition, disconnection rates do not decline to zero since some stayers experience multiple disconnection spells.

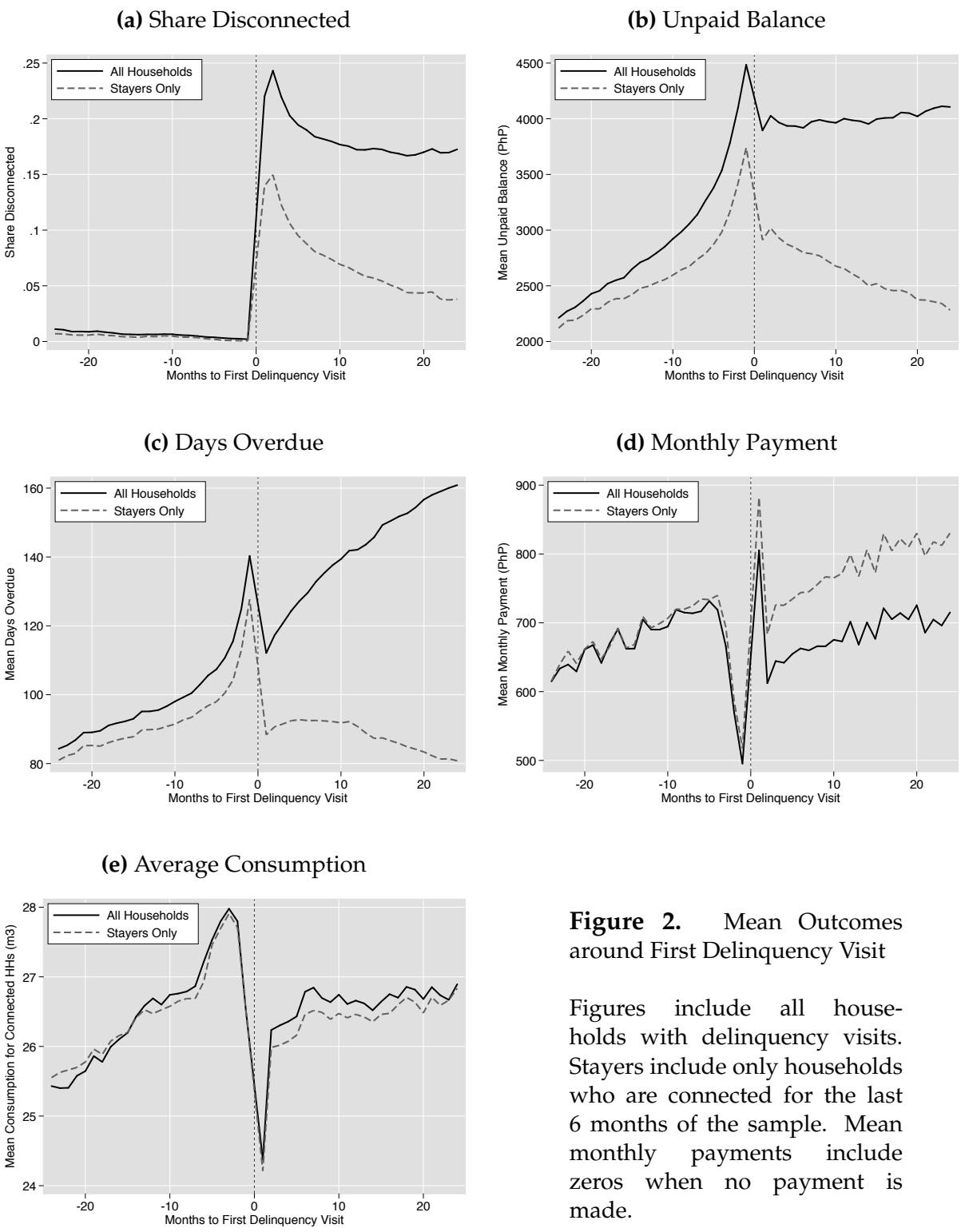


Figure 2. Mean Outcomes around First Delinquency Visit

Figures include all households with delinquency visits. Stayers include only households who are connected for the last 6 months of the sample. Mean monthly payments include zeros when no payment is made.

a visit.

This descriptive evidence indicates that many households choose to disconnect for

long periods before finally paying for reconnection. This behavior is consistent with households facing credit-constraints, which prevent them from taking a low-cost loan to fund immediate reconnection. Instead, households substitute to lower-quality alternative sources of water until they can save enough income for reconnection. Credit constraints would additionally predict that the most delinquent households at the time of the visit may be the most likely to disconnect following a visit. The data support this hypothesis, finding that the share disconnected two months after a visit is 32% for stayers that are over 90 days delinquent at the time of the visit. The corresponding share for stayers under 90 days delinquent shrinks to 4%.

Another hypothesis may be that households choose to stop paying when they leave their homes for vacation or overseas work. This mechanism would likely predict a large decrease in water consumption in the months preceding delinquency visits. Instead, consumption rises consistently between 24 and 2 months before a visit. Consumption then drops one month before, during, and after a visit, before quickly returning to an average level. This dip in consumption likely corresponds to connections that are disconnected for less than a month before being reconnected and having their consumption recorded for that month. Overall, this variation is small given a mean consumption for stayers of 26.2 m3 with a standard deviation of 12.3. Moreover, delinquency visits are relatively rare, which may make their exact timing difficult for households to predict.

5. Model

$$E_t\Big[\sum_{\tau=t}^{t-\tau} u(w_\tau, c_\tau)\Big] \tag{1}$$

$$c_t + p(w_t)w_t = y_t + A_t - \frac{A_{t+1}}{1+r_t^a} + B_t - D_t\frac{B_{t+1}}{1+r_t^b} \tag{2}$$

$$r_t^a = \begin{cases} r_l & \text{if } A_{t+1} \leq 0 \\ r_h & \text{if } A_{t+1} > 0 \end{cases} \tag{3}$$

$$r_t^b = \begin{cases} r_w & \text{if } A_{t+1} \leq 0 \\ r_h & \text{if } A_{t+1} > 0 \end{cases} \tag{4}$$

$$B_t - D_t p(w_t)w_t \leq B_{t+1} \leq 0 \tag{5}$$

Table 3. Estimates

	Estimate	Standard Error
Interest Rate	0.038	0.00
Income Variance	0.270	0.00
Water Preference	0.019	0.00
Fixed Cost of Non-Piped Water	207.0	0.00

Table 4. Fit

	Data	Estimated
Mean Usage (m3)	24.9	24.6
SD Usage	11.1	2.3
Mean Water Debt (PhP)	1205	1412
SD Water Debt (PhP)	1258	1955
Corr. Usage and Water Debt	0.35	0.05
Mean Disc. for 1 month	0.061	0.073
Mean Disc. for 2 months	0.061	0.047
Mean Disc. for 3 months	0.048	0.030
Mean Disc. for 4 months	0.040	0.017

6. Model Primitives

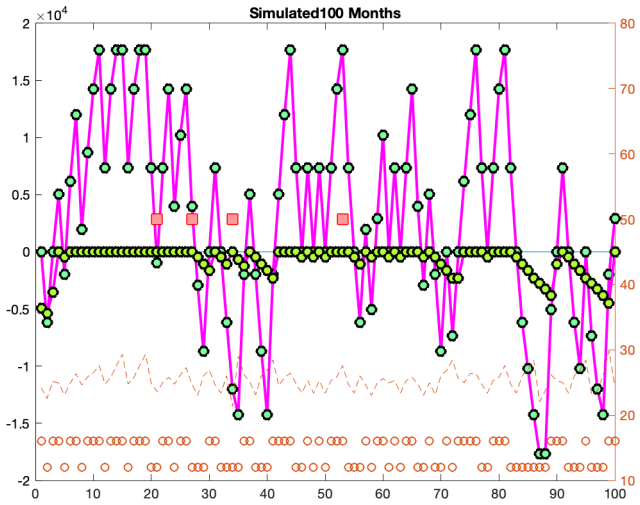
Karlan and Zinman [2009] find money lenders regularly charge at least 20% per month for credit. Giné and Karlan [2014] offer small monthly loans of 1,000 PhP at 2.5% monthly interest.

Andreoni and Sprenger [2012] estimate rates between 25% and 35% in an experimental setting and confirm exponential discounting. Laibson et al. [2007] use a similar consumption-savings structural approach and recover a discount rate of around 15%. Gourinchas and Parker [2002] use a similar structural approach finding a lower discount rate of around 5%.

Table 5. Counterfactuals

	Current	No Water Credit	No Water Credit and Revenue Neutral
Water Credit Interest Rate	0.0	1.0	1.0
Mean Usage (m3)	26.2	24.9	26.7
Compensating Variation		-52.5	3.2
Delinquency Savings	20.8	20.8	0.0
Price Intercept	20.2	20.2	17.3

Figure 3. Simulated Months



7. Results

8. Appendix

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Table 6. Linear Probability of Receiving a Delinquency Visit

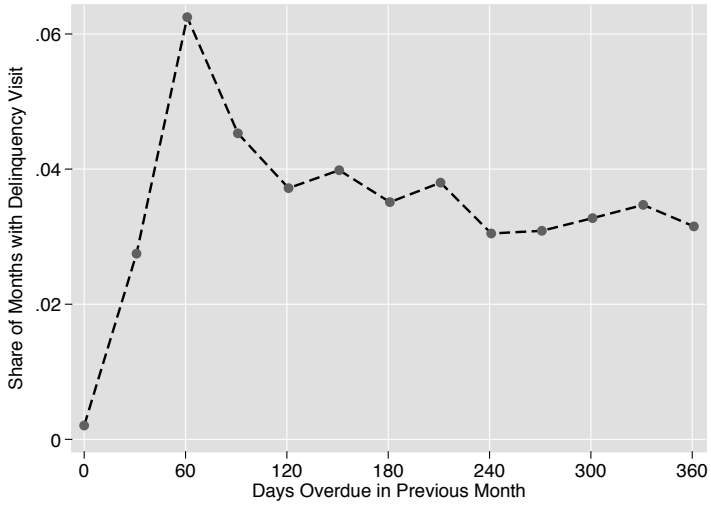
	(1)	(2)	(3)
Usage t-1	-0.0000150[a]	-0.0000186[a]	-0.0000225[a]
	(0.0000052)	(0.0000052)	(0.0000079)
Days Delinquent t-1	0.0000524[a]	0.0000581[a]	0.0000499[a]
	(0.0000016)	(0.0000016)	(0.0000020)
Unpaid Balance t-1	0.0000009[a]	0.0000009[a]	0.0000011[a]
	(0.0000001)	(0.0000001)	(0.0000001)
Single House	-0.0001480	-0.0001468	
	(0.0002032)	(0.0002050)	
Apartment	-0.0004173[b]	-0.0005555[a]	
	(0.0001861)	(0.0001869)	
Age of HoH	-0.0000398[a]	-0.0000373[a]	
	(0.0000040)	(0.0000040)	
HoH Low Skill Empl.	0.0005415[a]	0.0005333[a]	
	(0.0001827)	(0.0001830)	
HH Size	0.0003462[a]	0.0003482[a]	
	(0.0000363)	(0.0000364)	
Employed HH Members	-0.0002883[a]	-0.0002957[a]	
	(0.0000573)	(0.0000574)	
Location		✓	
Year ×Month FE		✓	✓
Household FE			✓
N	1,951,543	1,948,783	1,951,543
Mean Visits Per Month	0.0072	0.0072	0.0072

Std. errors clustered at the HH-level. [c] p<0.10,[b] p<0.05,[a] p<0.01

Table 7. Estimating Sample Construction

	Observations	Observations Removed
Initial sample	3,343,644	
Keep residential connections (excluding commercial)		414,615
Keep connections with payment records		68,509
Keep months with consumption under 200 m3		8,669
Keep bills > -5,000 PhP and < 80,000 PhP		116
Keep unpaid bills > -5,000 PhP and < 80,000 PhP		5,893
Keep payments > -80,000 PhP and < 80,000 PhP		1
Keep connections with over 30 months of records		1,360
Keep connections serving a single household		721,146
Drop connections that are disconnected for final yr.		92,459
Final sample	2,030,876	

Figure 4. Stayers Share of Households that Receive a Delinquency Visit depending on Days Delinquent in the Previous Month



Only stayer households.

Table 8. Descriptives for Stayers

	Mean	SD	Min	25th	75th	Max
Usage (m3)	26.2	17.5	0.0	15.0	33.0	200.0
Bill	761	1,124	-4,640	287	920	78,409
Unpaid Balance	2,416	5,070	-4,995	261	2,346	79,904
Share of Months with Payment	0.60	0.49	0.00	0.00	1.00	1.00
Payment Size	1,214	1,498	0	426	1,482	61,298
Days Delinquent	84.9	155.4	0.0	0.0	91.0	720.0
Delinquency Visits per HH	1.32	0.61	1.00	1.00	2.00	6.00
Months Disconnected	0.03	0.17	0.00	0.00	0.00	1.00

Total Households: 8,260 Obs. per Household: 61.8 Total Obs.: 509,959